

DIVISION 8

MISCELLANEOUS CONSTRUCTION

8-20 ILLUMINATION, TRAFFIC SIGNAL SYSTEMS, AND ELECTRICAL

8-20.1 Description SUPPLEMENT

The work to be performed shall consist of the installation of a complete and operable traffic signal and illumination system at the intersection of **(LOCATION)** in the City of Redmond.

Work at this intersection shall include furnishing and installation of fully equipped NEMA TS2, Type I, "P" controller cabinet, service cabinet, and a fully functional traffic signal system including traffic signal and pedestrian poles, vehicle and pedestrian signal heads, pedestrian push buttons, luminaires, Opticom™ detectors, junction boxes, conduit, conductors, and other incidental materials as may be required to comply with the Plans and these Specifications. **(FOR CIP PROJECTS, THIS LIST MAY BE REVISED IF THE CITY IS PROVIDING THE SIGNAL EQUIPMENT.)**

All materials and methods required under this section, unless otherwise superseded herein, shall conform to the **2000 edition of the Washington State Department of Transportation *Standard Specifications for Road, Bridge, and Municipal Construction*** (herein referred to as **Standard Specifications**), to all current amendments to the **Standard Specifications**, to the **State of Washington Standard Plans**, to the **State of Washington Signal Fabrication Manual**, to the **City of Redmond Standard Specifications and Details**, to the **1999 edition of the National Electric Code (NEC)**, and to the current ***Manual on Uniform Traffic Control Devices (MUTCD)*** as adopted by the State of Washington.

8-20.1(3) Restrictions on the Schedule of Work NEW

A. Mast Arm Erection

Mast arms should not be erected more than 14 calendar days prior to the signal system being turned on.

B. Signal Head Installation

The vehicle and pedestrian signal heads and push buttons shall be covered immediately upon installation and shall remain covered until the signal is turned on.

C. Work in Roadway

The roadway shall be kept open to traffic at all times, except when specific tasks required by this Contract require construction in the roadway. All work within the traveled way of any roadway shall be limited to the hours between 9 a.m. to 3 p.m. Work shall be accomplished such that at least 1 lane of traffic is open in each direction on every leg

during working hours, except for mast arm erection. Exceptions to this will require a 3-day advance approval from the Engineer.

D. Traffic Control During Construction

The Contractor shall submit a detailed traffic control plan and obtain approval from the Engineer prior to roadway trenching, erection of mast arms, installation of induction loops, and other activities requiring lane closures or detours. During traffic interruptions, traffic will be controlled by qualified flag persons unless otherwise specified.

During the erection of mast-arm assemblies, the Contractor, with the authorization of the Engineer, may block all traffic lanes for a maximum of 5 minutes between 9 and 11 a.m. on any day of the week. Work performed on Saturday, Sunday, or holidays requires the presence of a City inspector.

Unless otherwise approved by the Engineer, the Contractor shall furnish an off-duty police officer for traffic control during all roadway work performed at night, for all roadway work performed within 150 feet of an intersection, and for all other conditions where the Engineer deems it necessary for safety. The off-duty police officer shall be in addition to all other personnel required for flagging.

E. Traffic Signal Turn-On

Prior to schedule of turn-on, an electrical inspection must be passed with a copy of the Electrical Control Permit in the service cabinet.

The City of Redmond Traffic Engineer shall be given a minimum of **5** working days' notice of when turn-on is desired. The Traffic Engineer shall have at least 2 working days to completely check the installation of the traffic signal system after all work is completed by the Contractor. The Contractor shall correct any deficiencies prior to the Traffic Engineer granting approval for turn-on.

Signal turn-on shall not be allowed on Mondays, Fridays, weekends, holidays, and the weekday immediately before and after a holiday. Signal turn-on shall be completed between the hours of 9 a.m. and 2 p.m. on the day of the turn-on. No turn-on will be allowed until the Signal Turn-On Checklist in Appendix A has been completed and approved by the Traffic Engineer.

Before the controller is connected and the traffic signal made operational, the Contractor shall perform all field tests specified in Section 8-20.3(11) of the **Standard Specifications** and these **Special Provisions**.

The signal turn-on shall be by the City of Redmond Traffic Engineer. A City of Redmond Traffic Engineer or his representative shall enter all signal timing parameters as supplied by the Traffic Engineer and shall certify the intersection is operating and

functioning in accordance with the specifications. The Contractor shall be present during the turn-on with adequate equipment to repair any deficiencies in operation.

The traffic signal controller manufacturer's representative shall fully explain the operation of all control equipment to the City of Redmond personnel prior to the turn-on procedure. The Contractor shall contact the manufacturer to schedule the explanation of the control equipment (**PRIVATE DEVELOPMENT PROJECTS**). The City shall contact the manufacturer to schedule the explanation of the control equipment (**CIP PROJECTS**). A training session shall be provided if deemed necessary by manufacturer's representative or the Traffic Engineer.

F. Permits

The Contractor will be responsible for coordinating, obtaining, and paying for all permits necessary to complete this work in a timely fashion. An electrical permit shall be obtained before beginning trench excavation.

8-20.1(4) Special Provisions Cost Included in Contract Price (CIP PROJECTS ONLY)

NEW

All costs incurred by reason of, or in connection with, the **Special Provisions** shall be included in the contract bid price.

8-20.1(5) Errors and Omissions

NEW

The Contractor shall immediately notify the Engineer upon discovery of any errors or omissions in the Contract Documents, in the layout as given by survey points and instructions, or of any discrepancy between the Contract Documents and the physical conditions of the locality. If deemed necessary, the Engineer shall rectify the matter and advise the Contractor accordingly. Any work done after such discovery without authorization by the Engineer will be done at the Contractor's risk.

8-20.1(6) Warranties

NEW

The Contractor shall provide a warranty for all material to be furnished under this Bid for a period of 1 year, unless otherwise specified, from the date of actual turn-on. The warranty shall apply to all material including those items not manufactured by the Contractor.

The warranty shall provide that all material at the time of delivery shall be free from defects in material and workmanship and shall be fit for the uses set forth in these Specifications.

The warranty shall assign responsibility to the Contractor for all costs of replacement or repair of defective materials except those materials supplied by the City. Replacement or repair shall be made within 5 working days following notification of a discrepancy.

The controller cabinet and all of its contents shall carry a 10-year limited warranty. This limited warranty must be protected in the event the manufacturer(s) is no longer able to honor a claim. The limited “warranty protection” must come from an insurance company approved by the Washington State Insurance Commissioner. The limited warranty shall be written on a declaration document and acknowledged by an authorized agency. The warranty exclusions, terms, and conditions shall be in writing and approved by the City of Redmond prior to turn-on of the traffic signal system.

8-20.2 Materials

SUPPLEMENT

The Engineer reserves the right to inspect the manufacturing process of all materials. Final inspection and acceptance of the installed materials will not be given until final installation and testing has been completed on the systems. Approval to install materials and equipment must be obtained from the Engineer at the job site before installation.

8-20.2(1) Equipment List and Drawings

SUPPLEMENT

Manufacturer’s technical information shall be submitted for all poles, mast arms, wire, conduit, junction boxes, control equipment, and all other items to be used on the Project. All approvals by the Engineer must be received by the Contractor before material will be allowed on the job site. Materials not approved will not be permitted on the job site.

The Engineer shall have 14 calendar days to review information for each submittal that is made.

Approval of shop drawings does not constitute final acceptance or guarantee of the material, but is solely to assist the Contractor in providing the specified materials.

8-20.3 CONSTRUCTION REQUIREMENTS

8-20.3(2) Excavating and Backfilling

MODIFICATION

Excavating and backfilling shall be performed in accordance with Section 8-20.3(2) of the **Standard Specifications** except as modified herein:

8-20.3(2)A Trench and Backfill

The Contractor shall provide trenching as specified herein, regardless of the material encountered, as necessary for complete and proper installation of the signal and illumination conduit. Trenching shall conform to the following:

1. Uniform Construction

Trenching for conduit runs shall be done in a neat manner, and the trench bottom shall be graded to provide a uniform grade, with a width and depth as specified herein. All trenches for placement of conduit shall be straight and as narrow in width as practical to provide a minimum of pavement disturbance.

2. Trench Inspection

No work shall be covered until it has been examined by the Engineer. Earth which fills around and over the conduit shall be free of rocks greater than 2 inches up to a depth of 6 inches. When trenching is being accomplished within the sidewalk area, the backfill can be made with acceptable materials from the excavation and shall be considered a necessary part of and incidental to the excavation in accordance with the **Standard Specifications**. The compaction requirements for the roadway backfill shall apply.

3. Saw Cut for Trench

Trenches in all paved areas shall be saw cut. The saw cuts shall be a minimum of 2 inches deep and shall be parallel. Slurry from saw cutting must be vacuumed up as cutting is taking place and disposed of properly.

4. Pavement Removal

Pavement shall be removed in a manner approved by the Engineer. The Contractor shall take care in removing existing paving not to damage the pavement outside of the saw cut lines.

5. Trench Depth

Trench depth shall provide 24 inches minimum of cover over all conduits.

6. Trench Width

The trench width shall be 4 inches or the conduit diameter plus 2 inches, whichever is larger.

7. Trenching Across Roadways or Other Paved Areas

Trenching across roadways shall be approved by the Engineer. The Contractor shall be responsible for providing all necessary traffic control measures, including, but not limited to, lighting and an off-duty police officer.

Trenches located within roadways and driveways shall be backfilled with control density fill (CDF) to the base of the existing pavement or within 3 inches of finished grade and covered with steel plates for 24 hours to prevent traffic contact with CDF. After the CDF has set, the trench shall be patched with asphalt concrete pavement. The pavement patch shall match the thickness of the existing roadway pavement or shall be at least 3 inches thick, whichever is greater. CDF shall meet the requirements of Section 2-09.3(1)E.

The City reserves the right to make additions or deletions to the trenching which prove necessary for the completion of this Project.

8. Trenching in Landscaped Areas

Trenches shall be placed to have minimum impact on existing landscaping and irrigation systems. Any damage due to the Contractor's operation shall be repaired or replaced by the Contractor at his own expense and to the satisfaction of the Engineer. Compaction below topsoil to be 80 percent of the requirements shown in the City of Redmond Standard Drawing No. 201.

9. Trenching Through Concrete Sidewalk Areas

Trenching in these areas shall require removal and replacement of the concrete to the limits of the existing sidewalk joints. The costs for removal and replacement shall be incidental to the trenching. Backfill trench with CDF, per City of Redmond Standard Drawing No. 201, or compaction to 95 percent Modified Proctor.

8-20.3(3) Removing and Replacing Improvements

SUPPLEMENT

Unless otherwise noted on the Plans, the Contractor shall protect salvage items from damage and shall deliver these items immediately upon their removal to a City of Redmond Maintenance and Operation Center facility. Any existing equipment and material for salvage that is damaged during removal or delivery shall be compensated for by the Contractor to the satisfaction of the City. All material from the existing signal system that will not be reused or salvaged will become the property of the Contractor and shall be removed from the Project.

All existing wires from terminated circuits shall be removed from the conduit system after completion of the new signal system.

The Contractor shall remove all nonessential junction boxes. The Contractor shall remove all foundations that are not to be reused to a depth of at least 3 feet below the existing or finished grade, whichever is lower, or removed entirely, unless otherwise noted on the Plans. The conduits connecting to the foundation shall be cut off and capped or removed as designated by the Engineer. Any such foundation or conduit left below the surface shall be noted on the as-built plans provided to the City by the Contractor.

The Contractor shall be responsible for disposing of all other waste created by the required salvage and removal of items shown on the Plans or specified herein.

8-20.3(4) Foundations

MODIFICATION

A. General Requirements

The Contractor shall provide all material for and construct the foundations for traffic signal poles, traffic signal controller, and service cabinet to the dimensions specified in the Contract Plans. The anchor bolt pattern circle shall match that of the item to be installed thereon.

All excess materials shall be removed from the construction site and disposed of at the Contractor's expense.

Concrete foundations shall be placed against undisturbed earth if possible. CDF shall be used to backfill around signal pole foundations that are not placed against undisturbed earth. Before placing the concrete, the Contractor shall block out around any other underground utilities that lie in the excavated base so that the concrete will not adhere to the utility line. The Contractor shall secure the anchor bolts required for the item to be mounted on the foundation. The Contractor shall also securely locate all conduit required, including a spare 2-inch conduit and a 1-inch conduit (slip base foundations only), to be used to connect the pole or controller cabinet ground wire to the ground rod in the nearest junction box. Concrete foundations shall be troweled, brushed, edged, and finished in a workmanship-like manner. Concrete shall be promptly cleaned from the exposed portion of the anchor bolts and conduit after placement. Concrete and steel rebar shall be furnished and placed as shown in the Contract Plans. Concrete Class 3000 shall be used for all foundations.

After a curing period of 2 weeks, the Contractor may install the traffic signal poles, controller cabinet, and service cabinet on the new foundations.

Where a foundation is placed adjacent to the back edge of the sidewalk, the top of the foundation shall be poured flush with the finished sidewalk grade. Where round foundations are allowed, the top 4 inches shall be square in shape with sides equal to the diameter. If necessary, the sidewalk shall be notched around the foundation and a 3/4-inch through expansion joint shall be provided at all points where the foundation and sidewalk are in contact, such that the foundation can be removed without damage to the surrounding sidewalk. If no sidewalk exists, the top of the foundation shall be as shown on the Plans.

Concrete sidewalk removal necessary as part of the installation of foundation shall be removed and replaced to the limits of existing joints. The costs for removal and replacement shall be incidental to the "Traffic Signal and Illumination System Complete" item. **(CIP PROJECTS ONLY.)**

Location of all concrete foundations shall be approved by the City of Redmond Traffic Engineer prior to excavation.

B. Controller Cabinet

The controller foundation shall conform to Redmond Standard Drawings No. 459 and 460, shown in Appendix B.

C. Service Cabinet

The foundation for the service cabinet shall be attached to the controller cabinet foundation as shown in Redmond Standard Drawings No. 459 and 460, shown in

Appendix B. All foundation locations shall be approved by the Traffic Engineer prior to installation.

8-20.3(5) Conduit

MODIFICATION

Conduit installation shall conform to Section 8-20.3(5) of the **Standard Specifications** except as supplemented or modified by these **Special Provisions**.

Schedule 80 polyvinyl chloride (PVC) shall be used in the roadway and at other locations specified on the Plans. Schedule 40 polyvinyl chloride (PVC) conduit may be used at all other locations. Aluminum conduit shall not be used. All conduit shall be consistent with the requirements of Section 9-29.1 of the **Standard Specifications**.

The Contractor shall provide and install all conduit and necessary fittings at the locations noted on the Plans. Conduit size shall be as indicated on the signal wiring schedule. If the Contractor elects to use larger conduit without reasonable justification, the Contractor will be responsible for any increase in cost due to other changes required.

When interconnect cable is part of a project, the conduit sweeps bringing the interconnect cable into and out of the junction boxes shall be offset as directed by the Engineer to accommodate the cable's tendency to curl. The conduit sweep shall have a minimum bend radius of 36 inches.

Conduits entering through the cabinet foundation shall be arranged toward the front of the cabinet for maximum accessibility as directed by the Engineer.

Conduits shall be capped during construction using manufactured seals to prevent entrance of water and debris. The conduits shall be cleaned before pulling wire. Spare conduits shall include a bull-line tape. Spare conduits shall be capped and labeled as City of Redmond conduits.

Each conduit entering the junction boxes shall be neatly upswept and shall terminate not less than 6 inches nor more than 8 inches below the lid of the junction box. The location of the conduit within the junction box shall be such that the side of the junction box through which the conduit enters shall indicate from which direction the conduit came.

8-20.3(6) Junction Boxes

SUPPLEMENT

All junction boxes shall be supplied by the Contractor. The locations of the junction boxes as shown in the Plans are approximate and the exact locations shall be determined in the field. Junction boxes shall be located outside the traveled way, wheelchair ramps and landings, and driveways. The new junction box shall not interfere with any other previous or relocated installation. The lid of the junction box shall be flush with its frame and with the surrounding area whether it be shoulder, sidewalk, or other surface. Placement of junction boxes shall also conform to the Redmond Standard Drawing No. 464 shown in Appendix B.

When included in the Contract Plans, junction box spacing for interconnect cable shall be 1 at every intersection or a maximum of 400 feet apart, whichever is less. Type 2 junction boxes shall be used.

All junction box lids shall be grounded in a manner that will allow removal of the lid without breaking the ground.

8-20.3(8) Wiring

MODIFICATION

Installation shall conform to the requirements of Section 8-20.3(8) of the **Standard Specifications** and as modified herein:

A. General

All wires terminated at a terminal block shall have an open end, crimp style solderless, insulated terminal. All terminals shall be installed with a tool designed for the installation of this type of terminal. Crimping with pliers, wire cutters, etc., will not be allowed. Terminals shall be color coded to the wire and sized to fit snugly on wire ends. No exposed conductor will be allowed. All wiring inside the controller cabinet and at intermediate points shall be trimmed and cabled together to make a neat and clean-appearing installation. No splicing of any traffic signal conductor shall be permitted unless otherwise indicated on the Plans. All conductor runs shall be pulled to the appropriate signal terminal compartment board with pressure type binding posts. The only exceptions shall be the splices for detector loops at the nearest junction box to the loops and splices in illumination circuits.

Each end of every conductor at each wire termination, splice, connector, or device shall have a PVC wire marking sleeve bearing as its legend the circuit number indicated in the wiring schedule. Where terminal strips are used as a connecting device between conductors, the terminal strips shall also bear the circuit numbers. All illumination circuits shall be labeled with a PVC marking sleeve bearing the circuit number at each junction box whether splices are present or not. Terminal strips in cabinets, or when used as a connection device between conductors, shall bear the circuit numbers.

B. Interconnect Cable

The Contractor shall provide and install a copper 6-pair shielded interconnect cable and a 6-strand single-mode fiber optic cable in designated conduits as shown on the Plans. Unless otherwise indicated, conduits for interconnect cables shall be completely separate from other conduits, except where a conduit connection is made between the controller cabinet and the interconnect cable. The shielded copper interconnect cable shall be terminated on a terminal strip within a designated controller cabinet or in a designated terminal cabinet. The Contractor shall terminate the fiber strands of the interconnect cable into a telemetry module within a designated controller cabinet or in a designated terminal cabinet.

C. Loop Lead-In Cable

The drain wire shall be snipped at each end and shall not be landed.

D. 5-Conductor Cable

One spare 5-conductor cable shall be installed between the controller cabinet and every Type 2 and 3 pole terminal cabinet. Six (6) feet of slack cable shall be coiled in the controller cabinet, and the cable shall be landed and labeled as a spare in the terminal cabinet.

8-20.3(10) Service

MODIFICATION

Power sources shown in the Plans are approximate only; exact location will be determined in the field. A 3-wire electrical service shall be used at 120/240 volts, single phase, 60 hertz AC between the power source and the service cabinet. The unfused power shall enter the service cabinet through a separate conduit.

The Contractor shall furnish and install a service cabinet as specified. The service cabinet shall be mounted on a concrete base with anchor bolts fastening to the inside of the base of the cabinet. The illumination components shall be connected to the 240-volt, 60-hertz power. The traffic signal components shall be connected to 1 of the 120-volt, 60-hertz elements. No modifications to the cabinet will be allowed.

The Contractor shall have the service inspected by the City of Redmond Building Department Electrical Inspector and shall be solely responsible for coordination with the power company to have the service energized.

8-20.3(11) Field Test

SUPPLEMENT

All work shall be completed in a manner that provides the inspector and Engineer with full knowledge of the construction. The work shall proceed in accordance with the approved construction schedule previously supplied to and approved by the City of Redmond. The inspector and Engineer may, at their option, cause work completed without their knowledge or inspection to be dismantled so that it can be inspected to their satisfaction. Appropriate megger, resistance, continuity, and inductance tests shall be performed in accompaniment with the City Traffic Engineer, Inspector, or Signal Technician.

8-20.3(13) Illumination Systems

8-20.3(13)A Light Standards

SUPPLEMENT

The luminaires shall be incorporated into a circuit independent of any existing illumination circuits. The luminaires shall be controlled by an integral photoelectric control prewired into and mounted on top of the luminaire located closest to the controller cabinet. The photoelectric cell shall be furnished and installed by the Contractor and oriented toward the north sky.

8-20.3(14) Signal Systems

8-20.3(14)B Signal Heads

SUPPLEMENT

All vehicle and pedestrian signal heads shall be securely covered with opaque (nontranslucent) material between installation and signal turn-on. Signal heads shall also be completely covered after testing and prior to signal turn-on.

Vehicle heads, which are to remain covered for a period AFTER turn-on of the signal, shall be covered with a heavy, waterproof, opaque canvas, khaki in color, securable by braided nylon rope. Visqueen duct tape shall not be allowed to secure the covers to the signal heads.

All vehicle signal heads shall have a 1/4-inch-diameter drain hole in their base.

All signal heads shall be mounted using a Type M or K mount as specified on WSDOT **Standard Plans** J-6f and J-6g. The Contractor shall provide and install all vehicular signal head mounting hardware. Mounting hardware will provide for a rigid connection between the signal head and mast arm or pole.

Position of the signal heads shall be as specified on the Pole Schedule. Signal heads shall be mounted on the mast arm such that the mount shall be located just below the red indication. The bottom housing of a signal face shall conform to the requirements as stated in the current approved edition of the **MUTCD**.

Optically programmed heads shall be used for signal heads that are identified in the Plans. The highest intensity of the red lens in the signal head shall be aimed at a point 4 times the posted speed limit from the stop bar (measured in linear feet). Final orientation of the optically programmed heads shall be approved by the City of Redmond Traffic Engineer in the field.

8-20.3(14)C Induction Loop Vehicle Detectors

MODIFICATION

Induction loops shall be constructed in accordance with Section 8-20.3(14) of the **Standard Specifications**, the **Standard Plans**, and the **Standard Drawings**, except as modified herein:

1. General

Install loop detectors during conditions of zero precipitation and when the pavement temperature is between 40 degrees F and 100 degrees F.

Clean roadway surface of debris, standing water, or other material which may enter the saw cut and thereby degrade the quality of the installation.

The Contractor shall mark the location of all loops. The Contractor shall consider any pavement degradation or utilities that may interfere with the proper installation of the loop detector. The Contractor shall notify the City of Redmond Traffic Engineer 24 hours in advance to obtain approval of the location of the loop detectors as laid out

prior to any cutting. At no time shall any of the saw cuts pass closer than 1 foot to any utility cover.

The Contractor shall determine the depth of the pavement section where the loop is to be installed. If the pavement section is less than the required depth of the saw cut, the Contractor shall consult the Engineer or the inspector for directions.

2. Saw Cutting Round Loops

Round loops shall be constructed in accordance with the requirements noted for Method A (Circular Saw). Construction shall conform to WSDOT **Standard Plan J-8a** as modified by the following:

Method A (Circular Saw)

1. Round saw cuts shall be 6 feet in diameter and shall be constructed using equipment designed for cutting round loops. The equipment shall use a concave, diamond-segmented blade. The saw cuts shall be vertical and shall be a minimum of 0.25 inches wide. The saw cut depth shall be a minimum of 2.5 inches measured at any point along the perimeter. Other methods of constructing the round saw cut, such as anchoring a router or flat blade saw, will not be allowed.
2. The bottom of the saw cut shall be smooth. No edges created by the differences in saw cut depths will be allowed.
3. All saw cut corners shall be rounded to a minimum 1.6 inches radius.
4. All saw cuts shall be cleaned with a 1000-psi high-pressure washer. Wash water and slurry shall be vacuumed out. Saw cut shall be blown dry with compressed air.
5. Loops shall be installed after paving the final lift of asphalt.
6. The loop shall be constructed using 3 turns of conductor if its home run is less than 400 feet, and 4 turns of conductor if its home run is greater than 400 feet. The conductor shall be installed 1 turn on top of the previous turn. All turns shall be installed in a clockwise direction.
7. Loop sealant shall be MSI 34271. Loop sealant shall be installed in 2 layers. The first layer shall be allowed to cool before the second layer is applied. Installation of the sealant shall completely encapsulate the loop conductors. A minimum of 1 inch of sealant shall be provided between the top of the conductors and the top of the saw cut.

In areas where no conduit exists between the junction box and the edge of roadway, conduit stub outs shall be installed. This installation may require curb and/or sidewalk replacement to install the required conduit sweeps. Holes greater than 3.5 inches in

diameter shall require an asphalt patch. Existing stub outs not being reused shall be plugged or removed from the junction box. Install a 2-inch conduit between each saw cut in the pavement surface and the junction box.

If the saw cut crosses a pavement joint or crack, the loop wire shall pass through an expanded section of saw cut, as shown in the Redmond Standard Drawing No. 455 in Appendix B, that shall be previously smoothed of any rough edges. The wire shall be laid through this area in such a way that the wire forms a small "S" in order to allow for any future pavement movement.

The Engineer or inspector shall approve the quality and location of all saw cuts and conduits installed.

3. Loop Wire Installation

A minimum of 2-inch-diameter PVC conduit as shown in the Plans shall be used to contain the loop lead-ins from the saw cut in the roadway surface to the junction box.

The Contractor shall coil at least 10 feet of extra wire at the junction box prior to placing it in the saw cut so that the loop wire will not require any splices.

The loop wires shall be placed in the saw cut so that at no time is any tension placed on the wires. The wires shall not bind against the pavement at any point in the saw cut.

The loop wires in the lead-in saw cut and loop conduit shall be twisted in a symmetrical fashion with a minimum of 3 twists per foot at a uniform rate of turns per foot between the loop saw cut and the junction box. The twisted loop wire shall be pulled into the junction box through the conduit placed between the saw cut and the junction box. Unless specified otherwise by the Engineer, there shall be wiring for no more than 3 loops (6 twisted loop wire conductors) in each lead-in (home run) saw cut.

Both ends of the conduit between the saw cut and the junction box shall be sealed to prevent water and loop sealant from entering the conduit and to prevent the wire from moving.

Application of the MSI 34271 loop sealant shall be applied in accordance with the manufacturer's recommendations using equipment recommended by the manufacturer. Application of hot-melt loop sealant shall be made with a pressure feed applicator in two equal lifts to a pavement having a surface temperature greater than 40 degrees F in accordance with the manufacturer's recommendations. **CRACK POTS OR GRAVITY FEED EQUIPMENT SHALL NOT BE PERMITTED.**

4. Connection to Loop Lead-In Cable

When the individual loops have passed the tests specified below, they shall be connected in series or parallel as required by the Plans or **Standard Specifications**.

After all appropriate loop wires are brought into the junction box and tagged to identify which wire goes to each loop and in which direction the loop wires are wound, the individual wires shall be spliced together and to the individually twisted shielded pair cable and brought back to the controller cabinet. The splicing shall be made in accordance with Redmond Standard Drawing No. 455 in Appendix B. The entire splice shall be encapsulated with nonvinyl-back 3M™ Scotchfill black mastic sealant. In summary it shall employ a compression butt joint, then covered with the sealant, then 3 layers of 3M™ 33+ electric tape.

5. Temporary Vehicle Detection

The Contractor is responsible for maintaining vehicle detection at all times on an existing signal system. The Contractor shall furnish and install temporary microwave detection on a single phase approach or video detection that can plug directly into existing detector racks for approaches with 2 phases immediately after any loops are accidentally disconnected or cut. The Contractor shall furnish and install temporary microwave detection on a single-phase approach or video detection that can plug directly into existing detector racks for approaches with 2 phases prior to disconnecting any existing induction loops. Microwave and video detection shall be positioned and installed as directed by the City of Redmond Traffic Engineer or Traffic Signal Technician. The microwave detection sensors shall be Microwave Sensors Model TC-26B or approved equal, and shall detect vehicle movement in 1 direction only. The video detection system shall be Trafficon VIP 3.2 video detection system or approved equal.

8-20.3(14)E Signal Standards

SUPPLEMENT

After delivering the poles or arms to the job site and before they are installed, they shall be stored in a place that will not inconvenience the public. All poles and arms shall be installed in compliance with Washington State Utility and Electrical Codes.

The poles shall be installed on leveling nuts and washers secured to the anchor bolts and with locking nuts and washers on the top of the base flange. The side of the shaft opposite the load shall be plumbed by adjusting the leveling nuts or as otherwise directed by the Engineer. The space between the concrete base and the bottom of the pole flange shall be filled with dry pack mortar to completely fill the space under the flange and be neatly troweled to the contour of the pole flange. A barrier shall be placed around the anchor bolts to prevent grout from entering the conduits. A plastic drain hose (3/8-inch diameter) shall be inserted through the mortar to provide drainage from the interior of the pole base and be trimmed flush with the interior and exterior surface of the mortar. Dry pack mortar shall consist of a 1 to 3 mixture of cement and fine sand.

8-20.3(14)F Terminal Cabinets

NEW

A terminal cabinet meeting NEMA 3R requirements with terminal strip shall be furnished and installed on each traffic signal pole as shown in the Plans. The terminal cabinets shall be mounted on the pole using a 4-inch-wide aluminum channel away from the traffic side, with the

bottom of the cabinet above the pedestrian signal heads where present and in no case less than 8 feet above the ground level.

The Contractor shall furnish and install an interconnect cable terminal cabinet(s) at the location(s) shown on the Plans.

8-20.3(14)G Emergency Vehicle Preemption System

NEW

The Contractor shall furnish and install an emergency vehicle preemption system according to manufacturer's recommendations, the **Special Provisions** and as shown in the Plans. The emergency vehicle preemption detectors shall be installed in a drilled and tapped hole in the top of the mast arm or on the pole. They shall be tightly fitted to point in the direction shown in the plan view.

The Contractor shall furnish and install phase discriminator units as required to obtain the necessary phase discriminator channels for each leg of the intersection.

The Contractor shall furnish and install detector lead-in cable for the emergency preemption system. No splicing will be allowed between the detector and the controller cabinet.

8-20.3(14)H Pedestrian Push Button Assembly

NEW

The Contractor shall provide and install the pedestrian push buttons and signs on the signal pole.

The push buttons will be mounted to the poles per WSDOT **Standard Plan J-5**. All mountings shall be securely fastened and approved by the Engineer.

The position of the pedestrian push buttons shall be located generally so that each points at the crosswalk which the button is intended to serve; however, final positioning for the optimum effectiveness shall be approved by the City of Redmond Traffic Engineer.

8-20.3(17) "As-Built" Plans

MODIFICATION

This section is modified as follows:

Upon completion of the construction and prior to the turn-on of any traffic control equipment, the Contractor shall furnish an "as-built" plan of each intersection showing all signal heads, pole locations, detectors, junction boxes, miscellaneous equipment, conductors, cable wires up to the signal controller cabinet, and with a special symbol identifying those items that have been changed from the original Contract Drawings. All items shall be located within 1 foot horizontal distance and 6 inches vertical distance above, below, or at the surface.

Measurement for work under Section 8-20 shall be as follows:

1. Traffic Signal and Illumination System Complete

All work included in the Plans or specified herein, with the exception of the items listed below, shall be considered as part of the work for "Traffic Signal and Illumination System Complete." No specific unit of measurement will apply, but measurement will be for the lump sum total of all items for a complete system to be furnished and installed.

2. Loop Detectors

Loop detectors will be measured per each for the actual number of loop detectors installed and shall be a complete functional loop including saw cut, sealant, loop wire, loop lead-in wire, splicing, and wired to cabinet field terminals.

3. Conduit

Conduit of the diameters shown in the Plans will be measured by the linear foot for the actual length of completed conduit in place.

4. Trench and Backfill

Trench and backfill shall be measured by the linear foot for the actual length of trench opened and backfilled.

5. Junction Boxes

Junction boxes of the type shown in the Plans will be measured per each.

6. Remote Terminal Cabinet

Remote terminal cabinets shall be measured per each for furnishing the cabinet; constructing the foundation; and all labor materials, tools, and equipment necessary to install the cabinet as shown on the Plans.

7. Interconnect Cable

6-pair and/or 6-strand fiber optic interconnect cable shall be measured by the linear foot for the actual length of cable in the conduit. The payment shall be full compensation for providing, installing, and making the connections required by the Plans and Specifications.

8-20.5 Payment (CIP PROJECTS ONLY)**MODIFICATION**

Certification of manufactured material must be supplied to the City of Redmond before any payment will be made for that item of work. The Contractor shall forward to the City any manufacturer's guarantees for any materials purchased.

The lump sum and unit contract prices listed below shall be full compensation for all labor, tools, and equipment required for furnishing and installing all materials necessary or incidental to the construction of complete new light standards, and signal and illumination systems with emergency vehicle preemption as shown in the Plans and herein specified including saw cutting, excavation, backfilling, concrete foundations, wiring, restoring facilities destroyed or damaged during construction, and for making all required tests. All additional material and labor not shown in the Plans, or called for herein, and which are required to complete the specified systems, shall be incidental to the construction and included in the lump sum contract price.

Payment shall be made for the following bid items:

1. Traffic signal and illumination system complete, lump sum.
2. 6-foot diameter induction loop detectors, per each.
3. Conduit pipe, 2-inch diameter, per linear foot.
4. Conduit pipe, 3-inch diameter, per linear foot.
5. Conduit pipe, 4-inch diameter, per linear foot.
6. Trench and backfill, per linear foot.
7. Junction box Type 1, per each.
8. Junction box Type 2, per each.
9. Junction box Type 3, per each.
10. Interconnect cable: 6-pair and/or 6-strand f.o. in conduit, per linear foot.

END OF DIVISION 8

DIVISION 9

MATERIALS

9-29 ILLUMINATION, SIGNALS, ELECTRICAL

9-29.2 Junction Boxes

SUPPLEMENT

Junction boxes shall conform to Standard Plan J-11a, except Type 3 junction boxes shall be modified to have a hinged dual lid per Redmond Standard Drawing No. 463 shown in Appendix B. Concrete junction boxes used exclusively for signals shall be inscribed with the message "TS" as described on Standard Plan J-11a. Concrete junction boxes used jointly for signals and lighting shall be inscribed with "TS" and "LT" as described on Standard Plan J-11a. Concrete junction boxes used exclusively for lighting shall be inscribed with the message "LT" as described on Standard Plan J-11a. Concrete junction boxes used exclusively for interconnect shall be inscribed with the message "INTC" with the same letter size as shown on Standard Plan J-11a. All junction box lids and frames shall be galvanized.

9-29.3 Conductors, Cables

MODIFICATION

A. Signal Cables and Conductors

Electrical conductors shall conform to the requirements of Section 9-29.3 of the **Standard Specifications**. Signal cable shall have stranded copper conductors and shall conform to IMSA Specification No. 20-1.

B. Interconnect Cable

The copper interconnect cable shall be a 6-pair duct telephone cable, using color coded No. 19 AWG solid conductors with copper shielding and a polyethylene jacket meeting REA Specification PE-39. The fiber optic interconnect cable shall be a 6-strand single-mode dielectric sheath central (DDX) core cable product number 7DDX-006-DXD.

C. Illumination Conductors

Illumination conductors shall be USE rated.

9-29.6 Light and Signal Standards

9-29.6(1) Steel Light and Signal Standards

SUPPLEMENT

A. Design Requirements

The Contractor shall provide and install all traffic signal and luminaire poles as specified in the Contract Documents. Shop drawings of all steel poles to be installed as a part of

this Contract shall be submitted and approved by the Engineer before the poles are ordered.

All signal poles, strain poles, mast arms, and signal bridges shall be designed in accordance with the “**Standard Specifications** for Structural Supports for Highway Signs, Luminaires and Traffic Signals,” AASHTO, 1994, as revised. 100-mile-per-hour wind speed shall be used for the design of signal poles that will support video detection equipment.

The vertical deflection at the free end of any cantilever arm to the dead load of the signals and signs shall not exceed 2 percent of the cantilever arm length. The horizontal deflection perpendicular to the arm at the free end of any cantilever arm due to the design wind load on the signals and signs and structure shall not exceed 5 percent of the cantilever arm length.

For poles that are **NOT** on the WSDOT preapproved list, complete calculations for structural design shall be submitted with the shop drawings for approval before fabrication or ordering material. These calculations shall include the stresses in the pole and cantilever arms; the deflections at the free end of the cantilever; the attachment of the signals and signs to the structure; the connection between the cantilever arms and vertical pole; and the pole section at handhole, base plate, anchor bolts, and foundation. All materials, construction, and assembly shall be as specified herein and on the Pole Schedule.

B. Fabrication Requirements

1. Tapered Shafts

The pole, luminaire davit top, and mast arm shafts shall be round in cross section and have a uniform taper. The taper shall continue through the luminaire davit radius.

The pole shaft and signal mast arm shall not vary in roundness greater than 1/16 inch in the straight sections of the mast arm assembly. Longitudinal seam welds in the shafts shall meet AASHTO, 1994, as revised.

All butt welds in the shafts shall have back-up rings and full penetration for 100 percent of the circumference and shall conform to all applicable sections of the **Standard Specifications**.

The round tapered pole shaft shall be made of 1-ply, hot rolled, basic open hearth steel. Structural steel having a minimum yield point of 40,000 psi or more shall be used for all structural parts and shall be galvanized after fabrication in accordance with ASTM A123.

A flange plate for the purpose of mounting the vehicle signal mast arm on the pole shaft shall be attached to the pole shaft and shall be supported with side plates tangent

to the shaft and gusset plates both top and bottom. Provisions for installing the signal wires between the vehicle signals and pole shaft shall be provided. All materials and construction shall conform to the Pole Schedule.

2. Luminaire Attachment

Only the traffic signal poles so indicated in the Plans shall be equipped with davit style luminaire arms, and shall incorporate a smooth 5-foot 9-inch radius bend at the end. A pipe tenon of diameter and length specified by the lighting manufacturer shall be provided in the end of the arm for attachment of the luminaire. A tenon shall be 2 degrees above level at the end.

Those traffic signal poles not equipped with luminaire arms shall include a luminaire extension plate with removable pole cap per City of Redmond Standard Drawing No. 424.

3. Handholes

A minimum 4-inch by 6-1/2-inch handhole reinforcing frame, complete with removable rain-tight cover, shall be welded into the shaft 18 inches above the base on the opposite side as the signal mast arm attachment. A second similar handhole shall be welded into the shaft directly behind the mast arm attachment. A grounding nut or provision in the handhole frame near the pole base for accommodating a threaded bolt or stud shall be provided on the inside of the shaft. A J-hook wire support shall be welded on the inside of the pole shaft at the height of the vehicle signal mast arm attachment.

4. Vehicle Signal Mast Arm

The shaft end of the mast arm shall have a steel flange plate welded to it that will permit the arm to be securely mounted on the flange plate specified for the pole shaft.

The flange plate shall telescope the large end of the arm and shall be welded by 2 continuous electric arc welds, one being on the outside of the plate, adjacent to the shaft, and the other one on the inside at the end of the tubular cross section. The flange plate shall have 4 holes for the high-tensile bolts, which shall match the 4 tapped holes in the mounting plate on the pole shaft, as well as an opening to match that provided in the pole shaft for installing the signal wire.

Tenons shall be welded to the mast arm at locations specified on the Pole Schedule in the Plans, for the purpose of mounting the traffic signals. Unused tenons shall have a secure detachable cover.

5. Anchor Base

A 1-piece steel anchor base shall be secured to the lower end of the shaft by 2 continuous electric arc welds. The base shall telescope the shaft and the one weld shall be on the inside of the base at the end of the shaft, while the other weld shall be on the outside at the top of the base as indicated on the Pole Schedule. The design shall be such that the welded connection shall develop the full strength of the adjacent shaft section to resist bending action.

Four (4) holes of adequate size to receive the anchor bolts shall be drilled in the base. Slotted holes 1/4 inch maximum larger than the anchor bolt diameter shall not be permitted.

Two-piece (2-piece) anchor bolt covers shall be included and provisions made for mounting same with stainless steel screws.

6. Anchor Bolts

Four (4) steel anchor bolts, nuts, and washers shall be furnished with each pole. Each anchor bolt shall have 1 round bearing plate with 1 hex nut tack welded to the bottom of the plate and shall have 7-inch-minimum thread on the top. Anchor bolt dimensions shall be per manufacturer's specifications. All anchor bolts shall be furnished complete with 2 heavy hex nuts and 2 hardened washers. The threaded end of the bolts and all nuts and washers shall be galvanized in accordance with ASTM A153.

7. Delivery

Scratching, marking, denting, or other damage to poles and fittings at the point of delivery shall be cause for rejection.

9-29.7 Luminaire Fusing and Electrical Connections at Light Standard Bases

SUPPLEMENT

Light standards shall be equipped with 2 in-line fuse holders with the fuses mounted inside the pole and readily accessible from the handhole. Fuse holders shall be SEC Model 1791-SF with FNM-5 or approved equal.

9-29.10 Luminaires

MODIFICATION

The luminaires to be furnished and installed by the Contractor on this Project shall meet the general requirements of Section 9-29.10 of the **Standard Specifications** except as modified by the following:

Luminaires shall be standard ballast in-head "cobra head" roadway type with a low-loss magnetic regulator ballast. The housing shall be finished in a durable gray Lektrocote and employ a 2-door system as manufactured by General Electric Lighting or approved equal. Shielding of 75 degree C rated wire shall be required where needed.

The light source shall be horizontal burning and the luminaire shall have a reflector or a refractive lens, or a combination thereof, for controlling the light output to produce a uniform pattern on the roadway. The luminaires shall have the following ANSI light distribution pattern:

Lateral:	Type III
Vertical:	Medium
Control:	Cutoff

The Contractor shall ascertain the correct lamp socket setting from the luminaire manufacturer to achieve the distribution pattern indicated above. All lamps shall be dated with the month and year on the base prior to installation in the socket. This is necessary for warranty purposes.

The lamps shall be clear burning, 240 volt, 250-watt high-pressure sodium vapor units rated at a minimum of 30,000 initial lumens with an average rated life of 24,000 hours.

9-29.13(3) Emergency Preemption

SUPPLEMENT

All emergency vehicle preemption equipment and materials shall be the 3M™ Opticom™ emergency vehicle preemption system.

The emergency preemption detectors shall be the 721 or 722 series Opticom™ detectors manufactured by 3M™. The model of detectors shall be as indicated in the Plans. The detectors shall be capable of detecting an optical signal generated by an Opticom™ brand emitter assembly (3M™ Company). The detectors shall detect the optical signals from the emitter, amplify the signal, and transmit it to the phase selector.

The detector lead-in cable shall be 3M™ Company Opticom™ Model 138 shielded detector cable.

9-29.13(7) Traffic-Actuated Controllers

MODIFICATION

The Contractor shall furnish an Econolite ASC2S-2100 controller with telemetry module.

The controller shall have internal traffic responsive (hard-wired) and time based coordination software packages which will operate in conjunction with the master coordinator for this arterial.

The controller shall be capable of communicating with an on-street system master. This capability shall be provided by a separate telemetry module, which shall be included in the controller. The telemetry module shall receive system master commands and data transmissions. In addition, it shall transmit the controller status, database, and system detector information to the system master.

Under the traffic responsive mode, arterial master will specify that the local controller shall operate under a specific signal plan (consisting of Dial, Offset and Split criteria, or Time-of-Day plan). Other features which the arterial master may select include phase rotation, system detectors enabled, or traffic count accumulation.

The telemetry module shall provide the capability to upload/download the entire intersection database. Phase assignments for overlaps and preemptors shall not be downloaded to preclude unsafe controller operation. It shall be possible to inhibit downloading of phases in use and left-turn head control.

Telemetry shall utilize RS232 data transmission at 1200-19.2k baud. These may be leased lines (Type 3002, voice grade, unconditioned), dedicated cable, or fiber optic.

Parity and error checking shall be employed to assure transmission and reception of valid data. Indicators shall be provided on the telemetry module to show telemetry activity as follows: transmit, receive carrier, and valid data.

Traffic signal controller timing parameters may be accessed by a central microcomputer monitor or a portable laptop microcomputer such that timing may be uploaded (transmitted) from the controller to the monitor for review and editing if needed, and then downloaded from the monitor to the controller to update the timing parameters.

The controller unit shall be warranted for a period of 5 years. All warranty periods shall begin at the date of shipment.

9-29.13(7)B Auxiliary Equipment for Traffic-Actuated Controllers

Introduction

The following specifications set forth the requirements for the TS2 Type I traffic controller cabinet assembly. This includes the enclosure construction, interior assemblies, and electronic components. These items shall all meet applicable sections of NEMA Standards Publication TS2-1998. Where differences occur, this specification shall govern.

Cabinet Enclosure

The enclosure shall be manufactured from Type 5052-H32 aluminum with a minimum thickness of 0.125 inches. The standard size for the City of Redmond, unless otherwise specified by the City of Redmond Traffic Engineer, shall be Type 6 NEMA TS2 Type I as specified in Section 7.3 of NEMA standards. The enclosure shall be supplied with a powder-coated gray aluminum finish.

The door opening must be a minimum of 80 percent of the front surface of the enclosure. A rain channel shall be incorporated into the design of the door opening to prevent liquids from entering the enclosure. The top of the enclosure will slope 1 inch to the rear in order to prevent rain accumulation.

The main door and police door-in-door shall close against a weatherproof and dust-proof closed-cell neoprene gasket seal. The gasket material for the main door shall be 0.25 inch thick by 1.0 inch wide. The police door-in-door gasket material shall be 0.25 inch thick by 0.50 inch wide. The gaskets shall be permanently bonded to the enclosure doors.

The main door shall include a mechanism capable of holding the door open at approximately 90, 125, and 150 degrees. A stiffener plate shall be welded across the inside of the main door to prevent flexing.

The lower section of the door shall be equipped with a louvered air entrance large enough to allow sufficient airflow per the rated fan capacity. Louvers shall satisfy the NEMA rod entry test for 3R-ventilated enclosures. A noncorrosive, vermin- and insect-proof removable air filter shall be secured to the air entrance.

The handle shall not extend beyond the perimeter of the main door at any time. The lock assembly shall be so positioned that the handle shall not cause any interference with the key when opening the door.

The main hinge shall be a 1-piece continuous piano hinge with a stainless steel pin running the entire length of the door. The hinge shall be attached in such a manner that no rivets or bolts are exposed.

The main door shall be equipped with a Best Blue Core Construction tumbler lock. The police door shall be equipped with a Corbin No. R357SGS lock. Two (2) keys for the main door and one (1) key for the police door shall be provided with each enclosure.

Two (2) sets of "C" channels shall be securely mounted on each side interior wall (4 on each side) and 1 set on the rear wall of the enclosure for the purpose of mounting cabinet shelves and components. The channels shall accommodate spring nuts or studs.

All enclosures will be supplied with 2 removable shelves. The shelves shall be 10 inches deep.

All surfaces must be free of weld flash. Welds will be smooth, neatly formed, and free from cracks, blowholes, and any other irregularities. All sharp edges shall be ground smooth. All seams shall be sealed with RTV sealant or equivalent material on the interior of the enclosure.

Terminal and Facilities – Main Panel

The physical design of the panel shall conform as closely as possible to the current controller cabinets now in use by the City. The terminal and facilities layout shall be arranged in a manner that allows all equipment to be readily accessible.

The main panel shall provide for 16 load switch sockets, 6 flash transfer relays, 1 flasher socket and 3 BIU units. All sockets shall be silk-screened labeled on the front and rear of the main panel to match the drawing designators. All load switches and flasher shall be supported by a bracket extending at least half the length of the load switch.

Rack style mounting shall be provided to accommodate the required BIUs. A dual row, 64-pin, female DIN 41612 Type B connector shall be provided for each BIU rack position. Card guides shall be provided for both edges of the BIU. BIU mounting shall be an integral part of the main panel.

The connectors shall have wired and easily changeable address pins corresponding to the requirements of the TS2 Standard Specifications. The BIUs shall be capable of being interchanged with no additional programming. The address pins shall control the mode of operation.

The field terminal blocks shall be a single row, feed-through type. Each field terminal block shall have a screw Type No. 10 post capable of accepting no less than 3 No. 12 AWG wires fitted with spade connectors. Not more than 2 conductors shall be brought to any 1 terminal. Four (4) 12-position terminal blocks shall be provided in a single row across the bottom of the main panel for this purpose. **Magnum B4843-12NL-04**

Located above, and adequately spaced from, the field terminal blocks. Three (3) 16-position terminal blocks shall provide the flash programming capabilities per the NEMA TS2 Specification. Each terminal block shall have a screw Type No. 8, positioned in 1 horizontal row across the main panel. **Magnum A4003-16NL-04**

Unless otherwise specified by the City of Redmond Traffic Engineer, all main panels shall be programmed for red flash on all vehicle phases.

The terminal blocks for terminating the field conductors and the terminal blocks provided for flash programming shall be insulated minimum 600 volt, 10 amp.

Four (4) 12-position terminal blocks with No. 6 posts shall be located below the BIU units for testing the load switch inputs using a voltmeter. Additional terminal blocks with No. 6 posts shall be provided to access the controller unit's programmable and nonprogrammable input/output (I/O). **Beau 73212-49**

Main panel wiring shall conform to the following color and minimum wire size:

Green/Walk load switch output	14 gauge brown
Yellow load switch output	14 gauge yellow
Red/Don't Walk load switch output	14 gauge red
MMU (other than AC power)	22 gauge violet
Controller I/O	22 gauge blue
AC Line (power panel to main panel)	8 gauge black
AC Line (main panel)	10 gauge black
AC Neutral (main panel)	10 gauge white
AC Neutral (power panel to main panel)	8 gauge white
Earth Ground (power panel)	8 gauge green
Logic Ground	22 gauge gray
Flash Programming	14 gauge orange
Flasher Terminal	14 gauge black
Field Terminal	14 gauge red

All wiring 14 AWG and smaller shall conform to MIL-W-16878/1, Type B/N, 600V, 19-strand, tinned copper.

Conductors shall not be spliced between terminations. All wiring shall be neat in appearance. Mechanical clamps shall secure all connecting cables and wire runs. Stick-on type clamps are not acceptable.

Wire size 16 AWG or smaller at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity.

Lap joint soldering is not acceptable.

Controller and Malfunction Management Unit (MMU) cables shall be of sufficient length to allow the units to be placed on either shelf or the outside top of the cabinet in operating mode. Connecting cables shall be sleeved in a braided nylon mesh. The use of exposed tie wraps or interwoven cables is not acceptable.

The cabinet configuration shall be provided with enough RS-485 Port 1 communication cables to allow the full capabilities of the cabinet. Each communication cable connector shall be a 15-pin metal shell D subminiature type. The cable shall be a shielded cable suitable for RS-485 communication.

Pedestrian push button inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC.

Terminals and Facilities – Power Panel

The power panel shall be wired to provide the necessary power to the cabinet, Malfunction Management Unit, Cabinet Power Supply Unit, and auxiliary equipment. The panel shall be of such design so as to allow a technician to access the main and auxiliary breakers without removing the front cover.

Refer to NEMA TS2 Specifications Section 5 for cabinet power distribution and a complete of grounding system in the cabinet.

The power panel shall have the following components:

- 1. 40-amp main breaker**
- 2. 15-amp auxiliary breaker**

Breakers shall be thermal magnetic type, UL listed for HACR service, with a minimum of 10,000 amp interrupting capacity.

- 3. An EDCO model ACP-340 or exact approved equivalent surge arrestor. 10-amp breaker provided to remove power from electronics.**
- 4. 50-amp, 125 VAC radio interference line filter.**

5. **Normally open, 60-amp, mercury contactor. Durakool Model BBC-7032 or exact equivalent.**
6. **15-position neutral buss bar capable of connecting 3 No. 12 wires per position.**
7. **15-position ground buss bar capable of connecting 3 No. 12 wires per position.**
8. **A NEMA Type 5-15R, 15-amp UL-approved GFI outlet.**

Terminal and Facilities – Detection/Preemption

Three (3) vehicle detector amplifier racks shall be provided. Each shall support 16 channels of vehicle detection. Preemption components shall be contained in a separate 2-position rack.

The vehicle detection racks shall be 5 position racks each containing 1 BIU unit as an integral part of the rack. Power for the detection racks shall be provided by the cabinet power supply.

An interface panel shall be provided to allow for the connection of 48 independent field loops. The interface shall be mounted on the left side of the cabinet. Terminal blocks shall have a No. 8 post. The loop number associated with the termination point shall be identified. In addition to the vehicle detector loop terminations, the panel shall provide 10 positions to terminate the field wires for preemption detectors and also sufficient terminals to terminate the pedestrian field returns. A unique number shall identify termination points. A neutral bus bar.

Terminal and Facilities – Telemetry

The telemetry panel shall be located on the right side of the cabinet. One 20-position terminal block shall be provided for termination of the copper interconnect communication cable and a tie-point for required modem cable to the controller unit.

Fourteen (14) inches measuring from the top of the “C” channel on the right side of the cabinet will be reserved for a wall mounted fiber optic closet housing. The connector housing will be for a minimum 12-strand fiber interconnect. A Siecor Wall Mounted Closet Housing or an equivalent shall be provided as specified by the City of Redmond Traffic Engineer.

All cabinet cables required for connecting with the controller unit and required tie-points for cabinet wiring shall be provided as required to implement the fiber optic interconnect.

Auxiliary Panel and Police Door Switches

The police door-in-door switch panel shall contain the following:

Auto/Flash Switch. When in the flash position, power shall be maintained to the controller; and the intersection shall be placed in flash. The controller shall be stop timed when in flash.

The auxiliary panel on the inside of the door shall contain the following:

Auto/Flash Switch. When in flash position, power shall be maintained to the controller; and the intersection shall be placed in flash. The controller shall not be stopped timed when in flash.

Stop Time Switch. Stops the controller unit timing.

Signal On/Off Switch. In the “off” position, power shall be removed from the signal heads in the intersection. The controller shall continue to operate and the MMU shall not conflict or require reset.

Controller On/Off Switch. This switch shall turn power on or off to the controller unit.

Test Switches. Eight (8) vehicle test switches shall be provided to put test calls into the controller unit. Four (4) pedestrian tests shall also be provided. The switch type shall be momentary on/off push button type.

GFI Outlet. A NEMA Type 5-15R, 15-amp, UL-approved outlet.

Cabinet Equipment

The cabinet shall be provided with a **thermostatically-controlled ventilation fan** adjustable between 80–150 degrees. The fan shall be ball bearing type and shall be capable of drawing a minimum of 2.84 cubic meters (100 cubic feet) of air per minute.

Incandescent lamp socket shall be provided mounted in the cabinet to sufficiently illuminate the field terminals. The lamp shall be wired to a door-activated switch located at the top right of the door opening.

Cabinet Components

Load Switches. The load switches shall be solid state and meet NEMA TS2 Specifications. The front panel shall have indicators to show the state of each input and output circuit of the load switch. A minimum of 12 load switches shall be provided with each cabinet assembly.

Flasher: The flasher shall be solid state and shall conform to the requirements of Section 6.3 of the NEMA TS2 Specification. The flasher shall be rated at 15 amperes, double pole, with a nominal flash rate of 60 FPM.

Flash Transfer Relays. All flash transfer relays shall meet the NEMA TS2 Specifications as shown in Section 6.4 of the Specifications. A minimum of 4 relays shall be supplied with each cabinet.

Malfunction Management Unit. Each cabinet assembly shall be supplied with 1 Malfunction Management Unit as defined by the requirements of Section 4 of the NEMA TS2 Specifications. Eberle Design Inc., EDI MMU-16 with secondary messaging option is approved under this specification.

Bus Interface Units. All bus interface units (BIUs) shall meet the requirements of Section 8 of the NEMA TS2 Specifications. The full complement of approved BIUs shall be provided with each cabinet assembly to allow for maximum phase and function utilization for which the cabinet is designed. Each interface unit shall include power on, transmit, and valid data indicators. All indicators shall be LEDs.

Cabinet Power Supply. The cabinet power supply shall meet the requirements of Section 8 of the NEMA TS2 Specifications. The cabinet power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs. The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes. One (1) power supply shall be furnished with each cabinet assembly.

Detector Amplifiers. A minimum of 8 detector amplifiers shall be provided with each cabinet assembly. 3M™ Canoga Four Channel Amplifiers are approved under these Specifications. The detector shall meet all requirements of Section 6.5 of NEMA TS2 Specifications.

Preemption Devices. All system components shall be 100 percent compatible with the 3M™ Opticom™ System now in use by the City of Redmond. Discriminator modules approved under these Specifications are the 3M™ Opticom™ Model 762 and shall be rack mounted. The preemptor shall not flash the pedestrian yellow outputs in the field. Two (2) discriminators shall be supplied with each cabinet assembly.

9-29.16 Vehicular Signal Heads

MODIFICATION

All vehicle signal heads shall comply with applicable provisions of Section 9-29.16 of the **Standard Specifications** except as modified herein:

Vehicle signal heads shall be manufactured by McCain Traffic Supply. The vehicle signal heads shall be constructed of corrosion resistant, die-cast aluminum alloy and shall be painted Traffic-Signal Green and shall be equipped with tunnel-type visors and shall have a flat back mounting. All exterior surfaces of the signal head housing, doors, and visors shall have an electrostatically powder-coated finish. The vehicle signal heads shall be installed with LED indications for all sections. These shall be Dialight LED:

Red ball – 433-1210-003
Amber ball – 433-3230-001
Green ball – 433-2270-001
Red arrow – 432-1314-001

Amber arrow – 431-3334-001
Green arrow – 432-2374-001
Green/Amber arrow – 430-6370-00

Vehicle signal heads shall have 12-inch lenses. The highest intensity of the red lens in the signal head shall be aimed at a point 4 times the posted speed limit from the stop bar (measured in linear feet).

All vehicular signal heads shall be equipped with 12-inch aluminum tunnel visors.

9-29.17 Signal Head Mounting Brackets and Fittings **MODIFICATION**

Mounting assembly for Type M and N mounts shall be stainless steel.

9-29.18 Vehicle Detectors **MODIFICATION**

9-29.18(1) Induction Loop Detectors

The following materials are required for detector loop installation:

No. 12 AWG stranded copper wire, Class B, with chemically cross-linked polyethylene Type RHH-RHW insulation of code thickness, free of kinks and abrasions.

Loop lead-in wire shall be IMSA Loop Cable Specification No. 50-2, No. 14. Single pairs shall be used. The number of single pairs required shall conform to the "Loop Detector Spacing" Drawing No. 454 shown in Appendix B.

Loop sealant shall be MSI, Crafcro Loop Detector Sealant, Part No. 34271. Loop sealant shall be packaged in containers clearly marked "Loop Detector Sealant."

9-29.18(1)A Detector Amplifiers **NEW**

The Contractor shall furnish and install 4-channel Canoga C424T Induction Loop Amplifiers.

9-29.19 Pedestrian Push Buttons **SUPPLEMENT**

Pedestrian push button assemblies (including sign) shall conform to the requirements of Section 9-29.19 of the **Standard Specifications** and Redmond Standard Drawing No. 453 shown in Appendix B.

9-29.20 Pedestrian Signal **MODIFICATION**

Pedestrian signal heads employed on this Project shall be manufactured by McCain Traffic Supply. The pedestrian signal head shall be LED 430-6473-001.

The maximum overall dimensions of the signal shall be 19 inches wide, 18 3/4 inches high, and 19 inches deep, including "Z" crate visor and hinges. The signal shall be furnished complete with transformers installed. In order to facilitate installation and maintenance, the signal shall be designed so that all components are readily accessible from the front by merely opening the signal door.

Messages shall be international symbols depicting a Lunar White "walking person" and Portland Orange "hand".

A 1-piece neoprene gasket shall form a weather and moisture resistant seal. The "hand-walking person" symbols shall be a minimum of 12 inches in height and 7 inches in width. The inside face of the message lens shall be painted in all areas except where the desired figures are formed.

The first coating of paint shall be black to form a contrasting background when viewed from outside. The second coating of paint shall be white to increase additional over light output.

The case shall be a 1-piece corrosion-resistant aluminum alloy die casting. Integrally cast hinge lug pairs, 2 at the top and 2 at the bottom of each case, shall be provided for operation of a swing-down door. Prior to final assembly, the case, door frame, and "Z" crate visor (aluminum portion only) shall be thoroughly cleaned and chromate conversion coating applied inside and out per Military Specifications MIL-C-5541. A synthetic enamel conforming to Military Specifications TTE-529 shall then be electrostatically applied. Color and gloss are to be Traffic Green. The finish shall be oven cured for a minimum of 20 minutes at 350 degrees F. The unit shall be mounted with "clam shell" mountings as shown on the attached Plans. All terminal compartments shall be either ferrous metal or bronze.

9-29.24 Service Cabinets

MODIFICATION

The service cabinet shall be a Skyline Electric Drawing No. 47995-R2. A copy of the wiring diagram shall be provided in a plastic holder mounted conveniently inside the service cabinet. Nameplates shall be provided for each control component and shall be embossed phenolic with white letters on black background.

All sheet metal cuts will be cold galvanized at the fabricator. Finish shall match the controller cabinet with a minimum of 3 coats of Forest Coating No. 35-U-030 aluminum epoxy on the outside and oven-baked white enamel on the inside per Section 8-20.3(12) of the **Standard Specifications** and an acid-etch primer coat under the finish coat.

The service cabinet shall be equipped with a meter base at the top of the cabinet that is positioned to permit viewing the meter through a viewing port at the top of the cabinet door. The meter base shall be provided with a suitable device for providing circuit continuity in lieu of a meter that may be added at a future time.

The service cabinet wiring shall be arranged so that any piece of apparatus may be removed without disconnecting any wiring except the lead to that piece of apparatus. All wiring shall be appropriately marked with a permanent, indelibly marked, clip sleeve wire marker. Control wire shall be 7-strand No. 14 AWG THHN and all wiring shall conform to NEMA Class II C.

The service cabinet shall as a minimum be provided with the following:

- 4 JAW, 200-amp meter base.
- 125-amp 2P main breaker.
- 50-amp 1P signal branch.
- 15-amp 2P illumination branch (3).
- 30-amp 2P mag lighting contactor (3).
- 15-amp 1P control branch.
- Test switch to bypass remote photo control.

There shall be space within the cabinet for the future addition of 2 time clocks and 3 additional contactors. Each service cabinet door shall be equipped with 3-point latch and provisions for a padlock.

The service cabinet shall be shipped and delivered to the job site in a protective covering with suitable dunnage to prevent damage to the exterior finish.

9-29.25 Amplifier, Transformer, and Terminal Cabinets

MODIFICATION

A. Pole Mounted Terminal Cabinet

Pole mounted terminal cabinets shall conform to NEMA 3R requirements. Each cabinet shall have sufficient terminal blocks, with No. 10 lugs, to accommodate the conductors shown in the Wiring Schematic, plus 25 percent spare capacity.

The cabinet shall be constructed of welded 14 gauge (minimum) sheet aluminum and shall be of the following dimensions: 8 inches by 12 inches by 16 inches. The cabinet shall be gasketed with a 1-piece closed-cell neoprene gasket to provide a weatherproof and dust-proof seal. The cabinets shall be gray in color.

A door with stainless steel piano hinge shall be installed to provide complete access to the interior of the cabinet. The door shall be equipped with a lock that shall be capable of accepting a Best BM Series core.

END OF DIVISION 9

APPENDIX A

Signal Turn-On Checklist

APPENDIX B

Standard Drawings